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(54) Refrigerating appliances

(57) A refrigerating appliance which operates by means of the absorption-desorption of a fluid in a body comprises an energy collector (1) consisting of a housing (5) having an upper face (6) exposed to an intermittent supply of thermal-energy eg solar and lower face (7) on which is mounted a condenser 10. The body (14) arranged between the said faces is preferably of zeolite or activated charcoal. A space (9) is provided between the body and the lower face (7). An evaporator (2) is located in an insulating box (3). A tank (11) is connected to the housing (5) and evaporator (2) by respective conduits (8,4). A valve (20) is located in the tank (11) adjacent the end of conduit (4).

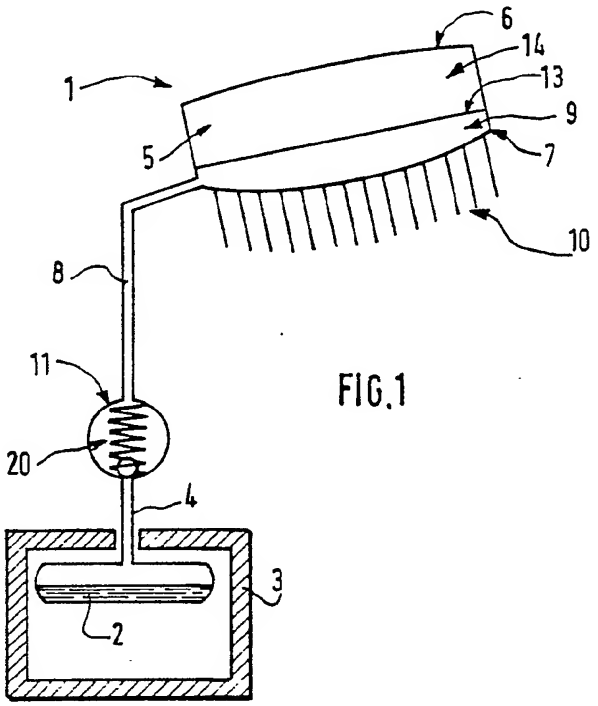

FIG.1

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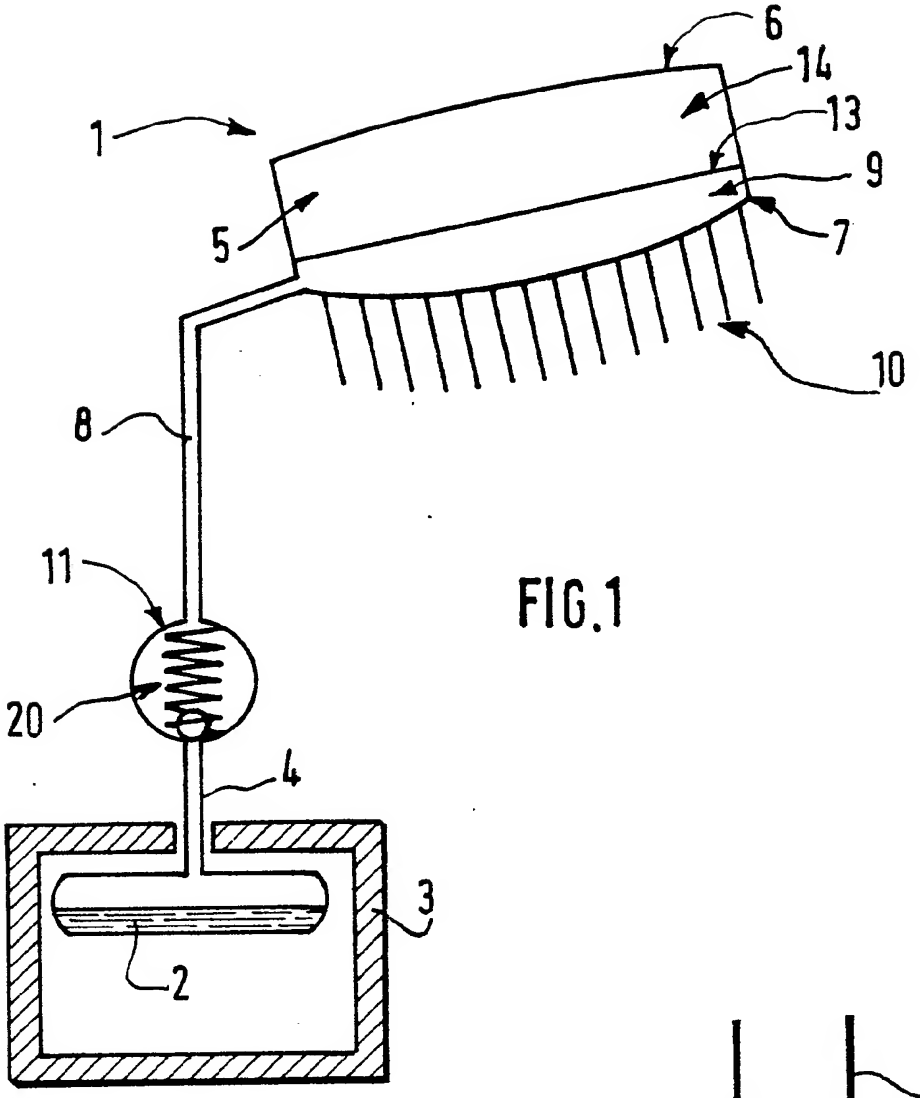

FIG.1

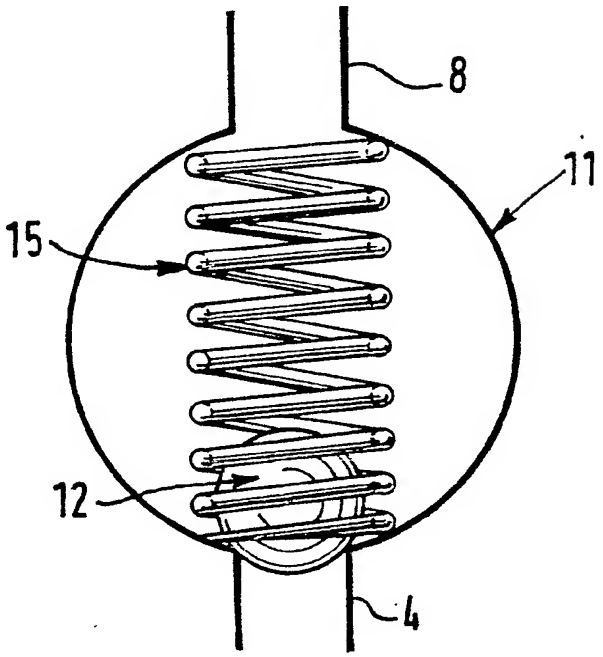

FIG.2

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THERMAL-ENERGY REFRIGERATING APPLIANCE

The invention relates to refrigerating appliances functioning by means of the intermittent supply of thermal energy and according to a cycle comprising a phase of adsorption of a fluid in a body and a corresponding desorption phase.

Such an appliance was described particularly in the Patent FR-A-2,574,530 or its equivalent US-A-4,686,836. The appliance comprises a thermal-energy collector and an evaporator located in a thermally insulating box. The thermal-energy collector consists of a sealed housing having an upper face exposed to a thermal-energy source and a lower face, to which is connected a conduit linking the housing to the evaporator.

Arranged between these two faces is a body having the requisite qualities of adsorption and desorption of a fluid. A space is provided between the adsorbent/desorbent body and the lower face of the housing, and a condenser is mounted directly on the lower face of the housing.

Preferably, a plane support provided with orifices is arranged under the adsorbent/desorbent body in order to keep the latter up against the upper face of the housing.

The condenser can, for example, possess fins arranged perpendicularly relative to the lower face of the housing.

The conduit preferably has a system which prevents the vapours from passing directly from the space provided in the housing to the evaporator during the desorption phase. This system can consist of a valve.

The disadvantage of such a refrigerating appliance possessing a valve is that human intervention is necessary twice in each cycle.

The object of the present invention is to overcome these disadvantages by means of a suitable system fitted on the conduit.

The main advantages afforded by the invention are

that it prevents vapours from condensing in the evaporator during the desorption phase and that the efficiency of the refrigerating appliance is increased, whilst at the same time the appliance is made completely automatic, that is to say without the need for human intervention.

The subject of the present invention is a refrigerating appliance, the functioning of which takes place by means of the intermittent supply of thermal energy and comprises a phase of adsorption of a fluid in a body and a corresponding desorption phase, the said refrigerating appliance comprising an energy collector and an evaporator located in a thermally insulating box, to which a first conduit is connected, the collector consisting of a sealed housing having an upper face exposed to a thermal-energy source and a lower face, to which a second conduit is connected, the body being arranged between the said faces and having the requisite properties of adsorption and desorption of the fluid, a space being provided between the body and the lower face, and a condenser being mounted on the lower face.

According to the invention, that end of the second conduit opposite the housing is connected to the upper part of a tank and that end of the first conduit opposite the evaporator penetrates into the tank in its lower part and carries a valve consisting of a spherical shutter penetrating at least partially into the first conduit and an element for guidance in a vertical axis.

The present invention will be understood better and other objects, advantages and characteristics thereof will emerge more clearly from a reading of the following description of an embodiment given as a non-limiting example, the description being accompanied by a drawing plate in which:

- Figure 1 shows a refrigerating appliance according to the invention,
- Figure 2 shows in detail an element of the refrigerating appliance according to the invention.

Referring to the Figures, the refrigerating appliance comprises a collector 1 which takes the form of

a housing preferably made of stainless steel. This housing has essentially two mutually confronting faces: an upper face 6 exposed to the thermal-energy source and a lower face 7. The interior of the collector 1 is filled with a body 14 having a high capacity for the adsorption or desorption of a fluid, such as zeolite which is a microporous aluminosilicate compound, the fluid used in this case preferably being water, or such as activated charcoal, in which case the fluid used is preferably methanol.

In the collector 1, a space 9 is provided between the body 14 and the lower face 7. The body 14 is retained against the upper face 6 by means of a plane support 13. The latter is held in place, for example, by means of lateral wedges (not shown). Since the body 14 is light, these wedges can be arranged only against the inner walls of the housing. The support 13 can, for example, be a netting or a perforated metal sheet. The holes made in the support must be such that the body 14 cannot fall into the space 9 and that the support remains permeable to the fluid.

Preferably, the faces 6 and 7 have a slightly concave shape. In fact, the interior of the housing is put under a partial vacuum, thus generating stresses exerted on the housing. These are reduced when this shape is employed. The same applies when the faces 6 and 7 have a slightly convex shape.

Reference can be made to the description of the abovementioned patent for a more detailed description of such a collector.

Arranged perpendicularly relative to the lower face 7 of the housing and on the outside of this are fins which, together with the space 9 and this lower face 7, form a condenser 10. The number and surface area of the fins are determined so as to obtain a condenser of a given performance.

The collector 1 is connected, by means of a first conduit 8, a tank 11 and a second conduit 4, to an evaporator 2 located in a thermally insulating box 3

which is filled, for example, with water.

The first conduit 8 is connected at one end to the space 9 provided in the collector 1, and the collector is arranged in such a way that the junction between the collector and the conduit 8 is the low point of the housing.

The first conduit 8 is connected at the other end to the upper part of the tank 11. The tank 11 can be of any shape, for example cylindrical, as shown in Figure 1. The volume of the tank is a function of the area of the upper face 6 of the collector 1 and of the volume of the adsorbent/desorbent body contained in the housing.

The second conduit 4 is connected at one of its ends to the upper part of the evaporator 2. The other end of the conduit 4 opposite the evaporator 2 penetrates into the tank 11 in its lower part and carries a valve 20.

The valve 20 consists of a shutter 12 of spherical shape, of a part of the conduit 4 at its end located in the tank 11, the shutter penetrating at least partially into the said conduit part, and of a guide element 15 surrounding the shutter 12 and making it possible to guide the movement of the latter in a vertical axis. The guide element 15 can consist particularly of a spring.

The functioning of the refrigerating appliance, which takes place by means of the intermittent supply of thermal energy, for example solar energy, will now be described.

In the presence of thermal energy, the temperature and pressure increase progressively in the collector 1. The body 14 discharges the fluid in the form of vapour by desorption. The first vapours formed condense on the face 7 of the housing and flow into the conduit 8. The fluid accumulates in the tank 11.

The pressure in the evaporator 2 is much lower than that prevailing in the collector 1 and the tank 11. Because of this pressure difference, the spherical shutter 12 closes off the conduit 4 completely. Thus, the vapours cannot pass directly from the space 9 provided in the collector to the evaporator 2.

If the thermal energy is solar energy, this desorption phase corresponds to the daytime phase.

When there is no supply of thermal energy, the temperature of the body 14 and the pressure in the collector 1 fall. The body 14 begins to adsorb the fluid which had accumulated in the tank 11. The pressure in the tank 11 falls, whilst that prevailing in the evaporator 2 remains constant. When the pressure in the tank 11 becomes less than the sum of the pressure in the evaporator 2 and of the buoyancy exerted on the spherical shutter 12, the spherical shutter is lifted, thus opening the entrance of the conduit 4. The fluid accumulated in the tank 11 passes completely into the evaporator 2 under the effect of gravity.

Because of the pressure difference prevailing between the tank 11 and the evaporator 2, the shutter 12 remains lifted and the body 14 continues to adsorb the fluid which now evaporates from the evaporator 2. Since the circuit is hermetically closed and evaporation is endothermic, there is a release of cold in the evaporator. The water contained in the insulating box 3, in which the evaporator is immersed, solidifies and thus contributes to keeping the temperature in the insulating box at a temperature in the neighbourhood of $0^{\circ}C$, even when adsorption has ended. This adsorption phase generating the cold continues until there is a new supply of thermal energy.

If the thermal energy is solar energy, this adsorption phase corresponds to the nighttime phase.

It will be seen that the system according to the invention makes it possible to prevent the condensed vapours from passing directly from the space 9 provided in the collector to the evaporator 2 during the desorption phase because of the pressure difference prevailing between the collector 1 and the evaporator 2. Thus, the release of heat caused by the condensation of vapours in the evaporator 2 is prevented, thereby increasing the efficiency of the refrigerating appliance. This efficiency is also improved because the fluid is introduced into the

evaporator at a temperature below that which it would have if it were to pass directly from the space 9 to the evaporator 2.

On the other hand, the quantity of fluid which has evaporated in the tank 11 before the shutter is lifted is absolutely negligible.

Moreover, it can be seen that the presence of the spherical shutter does not impede the passage of the vapours during the adsorption phase and therefore has virtually no influence on this operating phase of the refrigerating appliance.

The appliance described can function with zeolite as the adsorbent/desorbent body and with water as the fluid; the apparatus can also advantageously function with activated charcoal as the adsorbent/desorbent body and with methanol as the fluid.

In one exemplary embodiment, the tank 11 consists of a stainless-steel cylinder having a diameter of 150 mm, the shutter having a weight below 2.5 g.

Although only one embodiment of the invention has been described, it is clear that any modification made in the same spirit by a person skilled in the art would come within the scope of the present invention.

CLAIMS:

1. A refrigerating appliance, the functioning of which takes place by means of the intermittent supply of thermal energy and comprises a phase of adsorption of a fluid in a body and a corresponding desorption phase, the said refrigerating appliance comprising an energy collector and an evaporator located in an insulating box and to which a first conduit is connected, the said collector consisting of a housing having an upper face exposed to a thermal-energy source and a lower face, to which a second conduit is connected, the said body being arranged between the said faces and having the requisite properties of adsorption and desorption of the said fluid, a space being provided between the said body and the said lower face, and a condenser being mounted on the said lower face, characterised in that that end of the said second conduit opposite the said housing is connected to the upper part of a tank, and in that that end of the first conduit opposite the evaporator penetrates into the said tank in its lower part and carries a valve consisting of a spherical shutter penetrating at least partially into the said first conduit and of an element for the guidance of the said shutter in a vertical axis.

2. A refrigerating appliance constructed substantially as herein described with reference to and as illustrated in the drawing.

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